Capture-Recapture: Another means of estimating Abortion Prevalence in Nigeria

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ABSTRACT:

Estimating abortion prevalence is very crucial for public health, especially in the areas of reproductive health. Due to its illegality induced abortion complication has been adopted as one of the means by which abortion prevalence in Nigeria can be estimate. But in this paper, however, we suggested entirely different approach, the capture-recapture experiment. We demonstrated its usage by estimating abortion prevalence in Anambra State, South East Nigeria. Information on abortion were collected from two surveys—hospital out-patients and workplaces/schools/marketplaces. Based on the information collected, capture-recapture method was used to estimate the prevalence in the State. The two surveys identified a total of 390 abortions in the State in 2014. When this number was compared with the ascertainment corrected estimate of 1327 obtained with capture-recapture experiment, it appeared to represent 29% of the true abortion prevalence in the State. To the best of our knowledge this is the first use of such method to estimate abortion prevalence in Nigeria. We therefore advocate its usage in absence of any gold standard.

Key words: Capture-recapture, estimating prevalence, hidden population.

INTRODUCTION

Abortion is one of the leading causes of pre-mature deaths among Nigerian women, especially when the method is unsafe. World Health Organization (WHO) noted that despite dramatically increased use of contraception over the past three decades, an estimated 40-50 million abortions still occurs each year [1]. The Organization also noted that globally, approximately 13% of all maternal deaths are as a result of complications of unsafe abortion.

In Nigeria, as in other parts of the world, women experience pregnancies that are unplanned. Some of these women seek to terminate such pregnancies by self, medical methods if possible, but often by whatever means available. Abortion in Nigeria is no more news although the reason for this varies from woman to woman. Some obtain abortion because of health reasons while others may be as a result of economic factor or social norms.

Although Nigeria Law makes it a crime to perform or obtain abortion except to save a woman's life [2], yet abortion can be obtained from physicians providing the service secretly in private clinics and hospitals. Unsafe methods of abortion have continued to be cherished nationwide resulting to serious health consequences, including infertility [1]. Alan Guttmacher Institute (AGI) and Nigerian Campaign Against Unwanted Pregnant (NCAUP) far back in 1999 estimated maternal mortality in Nigeria at 1,000 maternal deaths per 100,000 live births, while an estimated one in every eight maternal deaths in West Africa are due to complications of abortion.

Although Nigeria Law prohibits abortion except to save a woman's life [2-3] the country's abortion rate is known to be higher than most Western European countries and similar to that of the United States of America where abortion is legal. Abortion rate in USA in 1999 was 23 per 1000 women aged 15 to 44years while in the same year, Nigeria women obtain approximately 610,000 abortions, leading to an abortion rate of 25 per 1000 women aged 15 to 44 years [3]. AGI also noted that the majority of the abortions (60%) are performed by non-physicians or even by women themselves often times under unsanitary conditions.

It can be noted that information on abortion is extremely limited in countries where abortion is legally restricted and official statistics not collected. This makes abortion one of the hidden populations. Hence, therefore, it is extremely difficult to estimate its prevalence with direct method. The use of indirect method of estimation, preferably capture-recapture (C-R) method would therefore be a better alternative to estimate this hidden population [4]. The method of C-R was first introduced to estimate animal abundance before it was extended recently to epidemiological studies. Based on the degree of overlapping among different sample data obtained from different health monitoring sources, an estimate of patients missed in the sample can be obtained [5].

The purpose of this study is to demonstrate how C-R method can be used to estimate abortion prevalence. To this end, C-R method is used to estimate abortion

prevalence in Anambra State, South East Nigeria. Anambra State has a population of 2,059,844 women, according to 2006 Population Census conducted by the National Population Commission (NPC) of Nigeria; and its landmass according to Anambra State Development Plan, 2014 is approximately 4,816.2 square kilometers. The State is one of the fastest developing States in Nigeria and fastest in the South East and therefore high abortion prevalence is suspected.

METHODS OF DATA COLLECTION/ANALYSIS
Data Collection

The difficulties of obtaining accurate information on the sensitive issues such as abortion are widely acknowledged and are especially severe in countries like Nigeria where official statistics of abortion is not collected due to its illegality. So, there is no existing list of women that had abortion anywhere in Nigeria. AGI and NCAUP in 1999 used only the number of women treated for induced abortion complications to estimate the abortion rate in Nigeria which they found to be 25 per 1000 women aged 15 to 44 years. In 2012, the Institute, using the same method, estimated 1.25 million induced abortions in Nigeria, equivalent to a rate of 33 abortions per 1,000 women aged 15-49 years. Their data, however, may have missed a lot of women who may have had abortion without complications or who may have obtained it from non-physicians and records of them not documented. The only reliable option in our thinking is for women to speak for themselves. In this regard, an anonymous self-report surveys designed to collect information on abortion were administered to women resident in the three major cities in Anambra State namely; Onitsha, Awka and Nnewi. Multistage sampling was used to select list of schools/offices/ market places and hospitals both public and private in these cities and by simple random sampling technique the surveys were administered to females at the age bracket of 14 to 49years in the categorized places mentioned above.

The sources of information used in this study were therefore coded response from respondents based on the first and second list of surveys disseminated on 6th and 10th July, 2014 respectively. Information requested in the survey were as follows: Local Government of Origin, Town of Origin, Place of Birth, Date of Birth and reason for obtaining the abortion. Out of 1000 surveys that were distributed to the hospital out-patients on 6th July, 2014, only 74 were completed and returned. Following the removal of 10 surveys that were not completed properly or that the respondents had had abortion before 2014, only 64 remained in the list. The mean age was 28.4years (SD = 7.4); 34.4% were aged between 14 and 24years; 65.6% were aged between 25 and 39years old. The second batch of the surveys was dispatched on 10th July the same month with the same information requested. With snowball technique and the assistance of Head teachers, various Student Union Presidents and Heads of various Market Associations in the State, the surveys were distributed to women within the particular age groups. To ensure confidentiality, boxes were stationed at a place where respondents could secretly return their completed survey forms from 12th to 30th July the same month. 1000 surveys were distributed out of which 326 remained in the list after
11 surveys that were not properly completed have been removed. The mean age was 23.2years (SD = 7.4); 38.7% were aged between 14 and 24years while 51.4% were aged between 25 and 39years old. Survey questions compiled from the two lists were then merged and by visual inspection, surveys with the same entries (matches) in both lists are identified.

Record Matching
Since response by respondents are anonymous, we used a linkage procedure recommended by [6] such as date of birth, place of birth and local government of origin, and additional criterion like reasons why the abortion was done as the key variable to remove duplications within each list and to identify overlaps among the two lists. Date of births is considered similar if they differ only by one digit [5]. No name of respondents was requested in the survey because of confidentiality. Table 1 specified the criteria used to determine matching individuals in the two lists and the number of matches that were identified, while Table 2 stated reasons abortion was obtained.

Table 1: Matching criteria used to identify overlap entries

Type of Match	No. of Matches	Local Govt. of Origin	Town of Origin	Place of Birth	Date of Birth
I	1	Same	Same	Same	Same
II	4	Same	Same	Same	Similar
III	7	Same	Same	Same/similar	Similar
IV	3	Same/similar	Same/similar	Similar	Same
V	2	Different	Similar	Similar	Different

Table 2: Reasons for obtaining abortion (M = 326)

Reasons For Abortion	No	%
To save life (or Health reasons)	24	7.4
Can't afford to look after the child (or Economic reasons)	152	46.6
To avoid premarital birth (or Societal norms)	150	46.0

Methods of Analysis

The live-births in Anambra State as at 2014 recorded by National Population Commission, Anambra State Office were 122,679. While the estimated population of women aged 15-49 years resident in the State as at December, 2014 using exponential ($N_t = N_0 e^{rt}$) method with the growth rate of (r =3.2) as adopted by the National Population Commission was

$$N_{2014} = 1058899 \, e^{3.2(8)} = 1376569$$

An estimate of the total number of abortion $\widehat{M}$ was estimated with the formula

$$\widehat{M} = \frac{(N_1+1)(N_2+1)}{R+1} - 1 \qquad (1)$$

where N_1 and N_2 are women who had abortion in the first and second list respectively, while R is the number of women identified having abortion in the first list and were also found in the second list (matches). This estimator is called Chapman index [7].

The following formulas, seen in [8], were used to calculate the variance of M and 95% confidence interval (CI) for the estimate M;

$$Var(\widehat{M}) = \frac{(N_1+1)(N_2+1(N_1-R)(N_2-R)}{(R+1)^2(R+2)} \qquad (2)$$

$$\text{and } 95\%CI = \widehat{M} \pm 1.96\sqrt{var(\widehat{M})} \qquad (3)$$

These formulas were also used to estimate age-stratum of women who had abortion.

DATA ANALYSES/RESULTS

Match types I through IV (Table 1) were considered to be true matches. In this regard, comparisons of the two lists identified 15 matches, yielding an estimate of 1,327 (95% CI = 792, 1862) women that had abortion in 2014 (Table 3). Kruskal-Wallis test was used to compare age distributions in the lists. The test shows that age distributions in the two lists were different ($p < 0.001$). Since this is the case, a stratified analysis was conducted yielding an estimate of 1299 (95% CI = 777, 1821) (Table 4).

Table 3: Estimates of Abortion in Anambra State (M) by Stratified Analysis

Age Group	List1	List2	No. of Matches	M	95% CI
All	64	326	15	1327	792, 1862

Table 4: Estimates of Abortion in Anambra State (M) by Unratified Analysis

Age Group	List1	List2	No. of Matches	M	95% CI
10-14yrs	2	19	1	29	10, 48
15-19yrs	8	54	3	123	45, 201
20-24yrs	13	67	5	158	73, 243
25-29yrs	12	92	3	301	85, 517
30-34yrs	10	37	1	208	0, 208
35⁺yrs	18	55	2	353	43, 663
Total	**63**	**324**	**15**	**1299**	**777, 1821**

Various criteria were adopted to estimate M (Table 5). Matches I-III which have more restrictive matching criteria increases the estimate of M by 23.1% to 1634. Conversely, using less restrictive criteria by including IV and V matches decreases the estimate of M by 11.1% to 1180. The estimates obtained from the six age brackets of samples and their 95% CI ranging from 29 (95% CI = 10 – 48) to 353 (95% CI = 43 – 663) are shown in Table 6. While estimates from four possible combinations ranging

from 1180 (95% CI = 741 – 1619) to 3541 (95% CI = 1064 – 6018) are shown in Table 3.3. There is estimated prevalence of 1327/1376569 x 10000 = 10 among females aged 14-49yrs old of existing data.

The ratio of live-birth and abortion in Anambra State as at 2014 stood at 1327 per 122,679 live-births, or simply put 1 per100 live-births.

Table 5: Estimates of Abortion in Anambra State (M) by the Number of Matches

Match type	No. of matches	M	95% CI
I-II	5	3541	1064, 6018
I-III	12	1634	883, 2385
I-IV	15	1327	792, 1862
I-V	17	1180	741, 1619

Table 6: Estimated Population of Female age group and their Abortion prevalence

Age Group	M	*2006 population of female by age groups	2014 population estimates of female by age groups $(N_t = N_0 \times e^{(3.2)t})$	Prevalence
10-14	29	242756	315583	1 per 10000
15-19	123	247304	321495	4 per 10000
20-24	158	224754	292180	5 per 10000
25-29	301	204648	266042	11 per 10000
30-34	208	153205	199167	10 per 10000
35+	353	307648	399942	9 per 10000

*National Population Commission (NPC) of Nigeria

N_t =NPC adopted method for population growth, where N_0 is the base year (2006)

DISCUSSION

Four assumptions underlying the use of two-source capture-capture method must be satisfied to produce valid results. The first assumption is that the two sources must be closed. Closed assumption can be controlled by the experimenter if the study period is short [9]. In our case, the study period was less than two months. The second assumption is that the two sources must be independent. The two surveys were dispatched independently namely; out-patients in the hospitals and schools/workplaces/marketplaces respectively. The third assumption is that all the members of the population must have equal chance of being captured. By simple random sampling technique, every member of the population surveyed has equal chance of being in the list. The fourth assumption is that capture history of each member must be clearly stated. All matches in this study were the true matches only. Criteria for these matches are local government of origin, date of birth, place of birth and reason for having abortion.

In 1999, Alan Guttmacher Institute and Nigerian Campaign Against Unwanted Pregnant estimated abortion rate in Nigeria to 25 per 1000 women aged 15 to 44years. The Institute estimated 33 per 1,000 women aged 15-49 years in 2012. Our research, however, estimated abortion rate in Anambra state to be 1 per 1000 women aged 15 to 44years, which is at the low rate, contrary to our expectation. Some women seek abortion to avoid premarital births [2], while others seek it because they can't afford to look after the child [1]. From our study, majority of women obtained abortion because of economic reasons and societal norms. This is inconformity with [1-2]. Cases of infertility among Nigerian women are at the increase and WHO noted that one of the causes of it is complication arising from unsafe abortion. The abysmal low abortion rate in Anambra state may not be unconnected with a wide range of contraceptives readily available, including family planning and even surrogacy—a practice where young women became pregnant to sell the baby—a practice which is at the increase in the state. Though contraceptive prevalence is significantly high its usage in Nigeria, however, is abysmally low [9-12]. This may not be the case in Anambra State, judging from our findings. However, this research confined only to one State out of thirty-six States in Nigeria and because of sampling errors and problems usually associated with response data, these results may not necessarily reflect the whole situation in Nigeria. We also note that this research is to simply demonstrate how C-R can be used to estimate

abortion prevalence in places where abortion is illegal but obtained secretly.

CONCLUSION

At first, it was our intention to use hospital records only to demonstrate the use of C-R methods to estimate abortion prevalence in Nigeria. However, due to its illegality, hospitals and clinics do not keep such records of abortion, which put our objective beyond reach. We therefore resorted to the use of survey. To the best of our knowledge, this is the first use of C-R methods to estimate abortion prevalence in Nigeria. We therefore recommend its usage when other gold standards are not feasible or too expensive.

AUTHORS' CONTRIBUTION

We declare that this work was done by the authors named in this article. U. A. Osisogu proofread the text while Walford Chukwu and Chinwuba E.E carried out the data collection, analysis and interpretation. All authors have read and approved the final manuscript.

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CONFLICT OF INTEREST

None declared.

REFERENCES

[1]   World Health Organization (WHO). Safe Abortion: Technical and Policy Guidance for Health Systems; 2003.

[2]   Oye-Adeniran. Complications of unsafe abortion: a case study and the need for abortion law reform in Nigeria. Reproductive Health Matters 2002;10(19): 19-22.

[3]   Alan Guttmacher Institutes. Sharing responsibility: Women, society & abortion worldwide. New York and Washington DC; 1999

[4]   Polnzio M, Perotti P.G, Monti C.M, Bartolommeo S.P, Iannello G, Mariani S. Prevalence estimates of alcohol related problems in the area of Northern Italy using the capture-recapture Method. European Journal of Public Health. 2010; Vol. 20 No.5, 576-581

[5]   Abeni, D.D, Brancato,G and Perucci, C.A. Capture-recapture to estimate the size of the population with Human Immunodeficiency virus type 1 infection. Epidemiology. 1993; Vol.5, No.4 pp 410-414

[6]   Seber, G.A.F. The Estimation of Animal Abundance (2nd ed). London: Griffin; 1982.

[7]   Seber, G.A.F. The effects of trap response on tag-recapture estimates. Biometrika. 1970; 26, 12, 13-33

[8]   Pollock, K.H; Nicholas, J.D; Browine, C; Hines, J.E. Statistical Inference for Capture-recapture Experiment. Wildlife Monographs. 1990; 107

[9]   BA Oye-Adeiran, IF Adeewole, KA Odeyemi, EE Ekanem, AV Umoh. Contraceptive prevalence among young women in Nigeria. J obstetrics and gynecology. 2005 vol. 25

[10]   EO orji, U Onwudiegwu. Prevalence and determinants of contraceptive practice in a defined Nigerian population. Journal of obstetrics and gynecology. 2005 vol. 25(2): 182-5

[11]   AC Ikeme, HU Ezegwui, AC Uzodima. Knowledge, attitude and use of emergency contraception among female undergraduates in Eastern Nigeria. Journal of obstetrics and gynecology. 2005 25(5); 491-3

[12]   Guttmacher Institute. The incidence of abortion in Nigeria. 2015 vol.(41)